

WHAT IS CLAIMED IS:

5 1. Apparatus for opening and closing a garage door comprising:

a motor having a rotatable member for rotating in a first direction to open the garage door and in a second direction to close the garage door;

10 motor control circuitry responsive to motor control commands for selectively connecting electrical power to said motor to cause rotation of said rotatable member thereby opening and closing said garage door;

15 control means for selectively sending one of a plurality of motor control commands to said motor control circuitry, said motor control commands specifying one of rotation of said rotatable member in said first direction, rotation of said rotatable member in said second direction, and no rotation of said rotatable member;

20 means for sensing the rotation of said rotatable member after the sending of at least a predetermined one of said motor control commands; and

25 means for sending fault control signals to said motor control circuitry when the rotation of said rotatable member sensed by said sensing means is not in accordance with the rotation specified by said at least one predetermined motor control command.

30 2. The apparatus of Claim 1 wherein said at least one predetermined motor control command specifies no rotation of said rotatable member and said fault control signals comprise signals specifying the rotation of said motor in said first direction.

35 3. The apparatus of Claim 1 wherein said motor comprises an up winding which, when connected to electrical power, rotates said rotatable member in said

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first direction and a down winding which, when connected to electrical power, rotates said rotatable member in said second direction; and

5        said motor control circuitry comprises:

      first switching means responsive to said control commands during fault free operation for connecting electrical power to a selected one of said up winding and an intermediate conductor;

10        second switching means responsive to said control commands during fault free operation for selectively connecting said intermediate conductor from said first switching means to said down winding; and

15        third switching means responsive to said control commands during fault free operation for selectively connecting electrical power to said up winding.

20        4. The apparatus of Claim 3 wherein said control means comprises:

      means for generating upward movement control commands defining upward movement of said door;

      means for generating downward movement control commands defining downward movement of said door;

25        means for generating stop commands specifying no movement by said door; and

      means responsive to said fault control signals for generating said upward movement signals.

30        5. Apparatus for raising and lowering a door comprising:

      a source of motor driving voltage;

35        a motor having an up winding which, when energized by said motor driving voltage, raises said door and a down winding which, when energized by said motor driving voltage, lowers said door;

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control means for generating control signals  
defining door movement;

5 first switching means responsive to said control  
signals during fault free operation for connecting said  
motor driving voltage to a selected one of said up  
winding and an intermediate conductor;

10 second switching means responsive to said  
control signals during fault free operation for  
selectively connecting said intermediate conductor from  
said first switching means to said down winding; and

15 third switching means responsive to said control  
signals during fault free operation for selectively  
connecting said motor driving voltage to said up winding.

6. The apparatus of Claim 5 comprising fault  
detecting means for detecting faults in the operation of  
said apparatus.

20 7. The apparatus of Claim 6 wherein said motor  
comprises a rotatable shaft and said fault detection  
means comprises means for sensing the rotation of said  
shaft.

25 8. The apparatus of Claim 6 wherein said  
control means comprises:

means for generating upward movement control  
signals defining upward movement of said door;

30 means for generating downward movement control  
signals defining downward movement of said door;

means for generating stop signals specifying no  
movement by said door; and

35 means responsive to the detection of a fault by  
said fault detection means for generating said upward  
movement signals.

9. The apparatus of Claim 5 wherein said

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control means comprises means for generating a downward movement control signal specifying the connection by said first switching means of said motor drive voltage to said second switching means via said intermediate conductor, the connection by said second switching means of the motor drive voltage from said intermediate conductor to said down winding and no connection by said third switch means between said motor driving voltage and said up winding.

10. The apparatus of Claim 9 wherein said control means comprises means for generating an upward movement control signal specifying the connection by said first switching means of said motor drive voltage to said up winding and the connection by said third switch means of said motor drive voltage to said up winding.

11. The apparatus of Claim 10 wherein said motor comprises a rotatable shaft and said apparatus comprises fault detection means for detecting improper rotation by said shaft in response to said control signals.

12. The apparatus of Claim 11 wherein said control means comprises means responsive to a fault detected by said fault detection means for generating an upward movement control signal.

13. The apparatus of Claim 5 comprising means responsive to the contemporaneous connection of said motor drive voltage to both said up winding and said down winding for inhibiting the energization of both said up winding and said down winding by said motor drive voltage.

14. The apparatus of Claim 5 wherein said

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s cond and said third switching means each comprises a normally open single throw relay contact set and said first switching means comprises a double throw relay contact set having an armature contact connected to said source of motor driving voltage, a normally open contact connected to said up winding and a normally closed contact connected via said intermediate conductor to one contact of said second switching means.

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